

# NASA TECH BRIEF

## *Ames Research Center*



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## Variable Dimension Automatic Synthesis Programs (VASP)

### The problem:

The Automatic Synthesis Program (ASP), that the Variable Automatic Synthesis Program (VASP) was derived from, is limited in two ways:

- (1) ASP is programmed in FAP (Fortran Assembly Program) and can only be used on the IBM-7090-7094 computers;
- (2) many complicated time-variant analysis, synthesis, and optimization problems tax the capability of the ASP program.

### The solution:

A Variable dimension FORTRAN IV version of the Automatic Synthesis Program was developed.

### How it's done:

The program is used to implement the Kalman filtering and control theory. Basically, it consists of 31 subprograms for solving most modern control problems in linear, time-variant (or time-invariant) control systems. These subprograms include operations of matrix algebra, computation of the exponential of a matrix and its convolution integral, and the solution of the matrix Riccati equation. The user calls these subprograms by means of a FORTRAN main program, and so can easily obtain solutions to most general problems of extremization of a quadratic functional of the state of the linear dynamical system. Particularly, these problems include the synthesis of the Kalman filter gains and the optimal feedback gains for minimization of a quadratic performance index.

The VASP is an outgrowth of ASP and has the following improvements:

- (1) a more versatile programming language;
- (2) a more convenient input/output format;
- (3) some new subprograms which consolidate certain groups of statements that are often repeated; and
- (4) variable dimensioning.

The pertinent difference between the two programs is that VASP has variable dimensioning and a more efficient storage.

The documentation for the VASP program contains a VASP dictionary and some example problems. The dictionary contains a description of each subroutine and instructions on its use. The example problems include dynamical response, optimal control gain, solution of the sampled data matrix Riccati equation, matrix decomposition, and a pseudo inverse of a matrix.

### Notes:

1. This program is written in FORTRAN IV to be utilized on the IBM-360 computer; however, the program can be used by other machines that have FORTRAN IV compilers.
2. Submitted by: John S. White  
Homer Q. Lee  
Ames Research Center  
Moffett Field, California 94035  
(ARC-10616)
3. Inquiries concerning this program should be directed to:  
COSMIC  
112 Barrow Hall  
University of Georgia  
Athens, Georgia 30601

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